

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 4301

Roll No.

--	--	--	--	--	--	--	--	--	--

B.Tech.

(SEM. I) THEORY EXAMINATION 2011-12

ENGINEERING MECHANICS*Time : 3 Hours**Total Marks : 100*

- Note :—**
- (i) This paper contains three Sections A, B and C. Section A carries 20 marks, Section B carries 30 marks and Section C carries 50 marks.
 - (ii) Attempt all the Sections. Marks are indicated against each question part.
 - (iii) Assume suitably any data, if missing.

SECTION—A

1. Attempt all parts : (10×2=20)
- (a) If the resultant of two forces of magnitude P has the magnitude P, then determine the angle between the forces.
 - (b) Explain the law of equilibrium for a body under three only forces.
 - (c) For perfect truss give the relationship between number of members and number of joint.
 - (d) How will you replace fixed support of a beam by reaction as a set of forces (or force system) ?
 - (e) What is the importance of axis of symmetry in determination of center of gravity of a body ?
 - (f) Explain principal Axis of Inertia.
 - (g) Describe the law of dynamic equilibrium for a body of mass m moving with acceleration 'a'.

- (h) Explain the relative velocity of a point on the circumference with respect to the center of a wheel rolling without slipping on a horizontal surface.
- (i) Draw stress-strain diagram for mild steel and highlight salient points.
- (j) Discuss the significance of section modulus of beam.

SECTION-B

2. Answer any three parts of the following : $(10 \times 3 = 30)$

- (a) Determine the force P required to hold a mass of mass 10 kg in equilibrium utilizing the system of pulleys as shown in Fig. 1. Assume that each pulley is of 3 kg.

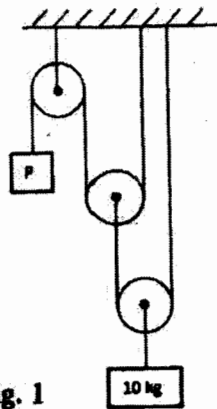


Fig. 1

- (b) Draw the shear force and bending moment diagrams of the overhanging beam shown in Fig. 2

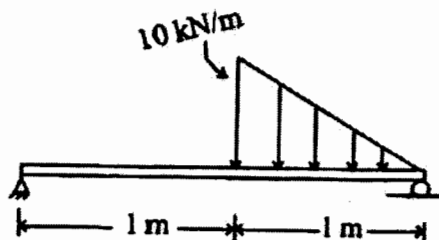


Fig. 2

- (c) The homogeneous wire ABCD is bent as shown in Fig. 3 and is attached to a hinge at C. Determine the length L for which portion BCD of the wire is horizontal. All dimensions are in mm.

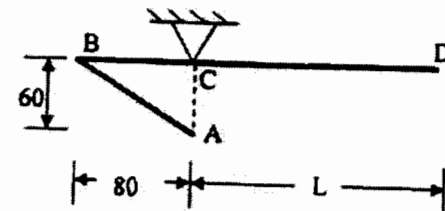


Fig. 3

- (d) A slender bar AB slides down a circular surface and on a horizontal surface as shown in Fig. 4. At an instant, when $\theta = 45^\circ$, velocity of the end A is 2 m/s. Determine the angular velocity of the bar and the velocity of point of contact on the circular surface.

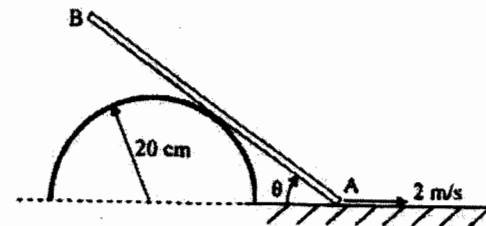


Fig. 4

- (e) A solid shaft of diameter 300 mm is proposed to be replaced by a hollow shaft of internal diameter equal to 0.7 times the external diameter. Determine the external diameter of hollow shaft, if the same power is transmitted at the same level of stress.

SECTION-C

3. Answer any one of the following : (10×1=10)

- (a) A 20 kg homogeneous smooth sphere rests on two inclined planes as shown in Fig. 5. Determine the contact forces at A and B.

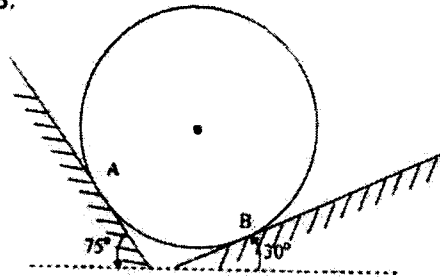


Fig. 5

- (b) A rope supports two masses as shown in the Fig. 6. Find minimum value of 'm' for equilibrium and corresponding tension in the rope between two fixed drums A and B. Take coefficient of friction between drum and rope as 0.25.

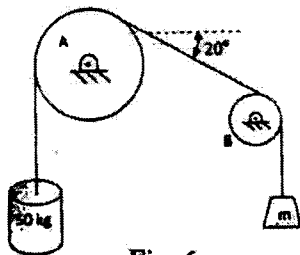


Fig. 6

4. Answer any one of the following : (10×1=10)

- (a) Determine the force in members FE, FC and BC of the truss shown in Fig. 7.

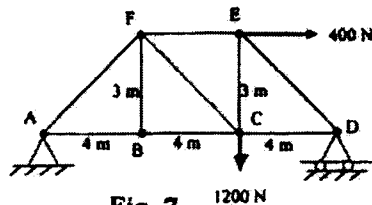


Fig. 7

- (b) Determine the support reactions for the cantilever beam shown in Fig. 8 and sketch shear force and bending moment diagrams showing key points.

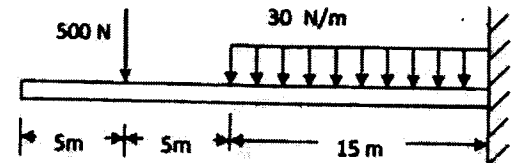


Fig. 8

5. Answer any two of the following : (5×2=10)

- (a) Determine the centroid of the area shown in Fig. 9. All dimensions are in mm.

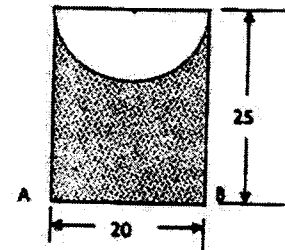


Fig. 9

- (b) Find the mass moment of inertia of a hollow cylinder about its axis. The mass of cylinder is 5 kg, inner radius 10 cm, outer radius 15 cm and height 20 cm.
- (c) Find the moment of inertia of T section as shown in Fig. 10 about the centroidal xx and yy axis. All dimensions are in mm.

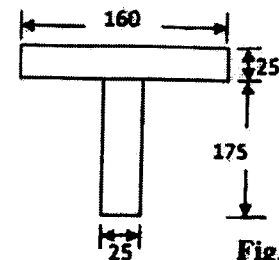


Fig. 10

6. Answer any two of the following : (5×2=10)

(a) The motion of a particle is defined by the relation $x = 6t^4 - 2t^3 - 12t^2 + 3t + 3$. Determine the time, position and velocity when acceleration is zero.

(b) The 30 kg disk, shown in Fig. 11, is pin supported at its center. Disc is at rest. A constant couple moment M of 5 Nm is applied on the disc and a constant force F of 10 N is applied at the end of a rope wrapped on the disk. Determine the number of revolutions made by the disc when its angular velocity becomes 20 rad/s.

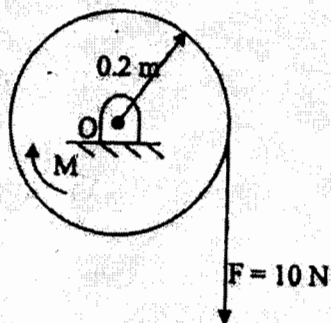


Fig. 11

(c) A rod of length 4 m and mass 20 kg is pivoted at one end and is rotated with an angular speed 10 rad/s in horizontal plane. Find the force on pivot due to rod and the tension in the rod at a distance of 2 m from the pivot.

7. Answer any two of the following : (5×2=10)

(a) Prove that the theoretical value of Poisson's ratio lies between 0 and 0.5.

(b) Determine the total axial extension of the bar loaded as shown in Fig. 12. Take $E = 2.5 \times 10^4 \text{ N/mm}^2$.

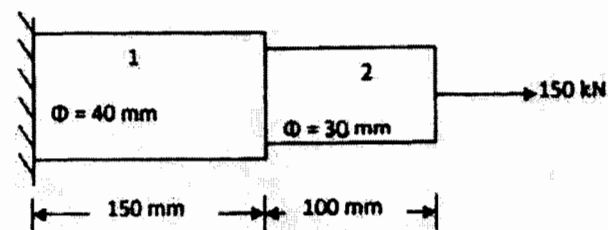


Fig. 12

(c) The beam in Fig. 13 has rectangular cross-section whose width is 100 mm and depth is 150 mm. Calculate the maximum bending stress in the beam.

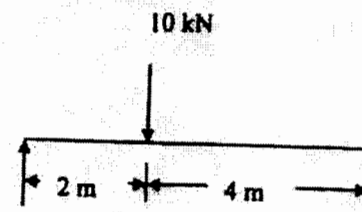


Fig. 13